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EP 00/06586

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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Recording and editing of A/V streams

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Recording and editing of A/V streams.

The invention relates to recording of a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, on a record carrier. The invention also relates to editing of such first and second information signals recorded on said record carrier, and to a record carrier. Recording of an MPEG encoded video signal on a magnetic record carrier is well known in the art. Reference is made in this respect to USP 5,579,183 (PHN 14.818).

In the prior art recording apparatus, known from the above identified document, a serial datastream of MPEG encoded information is received and packets comprising the MPEG encoded video signal are retrieved therefrom. Next, upon recording the MPEG encoded video signal, an error correction encoding and a channel encoding is carried out, resulting in blocks of information, the so-called ECC (error correction coded) blocks of information, that each are recorded in a fixed number of helical tracks, more specifically, 12 tracks. The blocks of information correspond to video information for time intervals of length 200 ms. Editing a video signal recorded on the record carrier will be carried out on the boundaries of those blocks, or: on the boundaries of the 12 track portions on the record carrier.

It turns out that, editing of such recorded video information causes problems, in that the corresponding edited audio signal is subject to distortions.

The invention has for its object to propose various measures to improve the possibilities of editing.

In accordance with the invention, the method for recording the first and second information signal is defined as claimed in claim 1, 4, 7 or 8. The method of editing the first and second information signal is defined as claimed in claim 11. Corresponding recording apparatuses are defined as claimed in the claims 19, 22, 25 or 26. A corresponding editing apparatus is defined as claimed in claim 29.

The invention is based on the following recognition. The serial datastream of MPEG encoded information not only comprises packets of the MPEG encoded video signal, but also comprises packets of an audio signal that corresponds to that video signal. During recording, also the audio packets of the corresponding audio signal are retrieved from the serial datastream and the composite datastream of the audio packets and video packets are treated in the way given above. The MPEG encoded audio signal is in the form of blocks (or: blocks) of audio information. As an example, for an audio signal encoded in accordance with MPEG-1 layer II at 48 kHz, the block-length is 1152 samples which represents 24 ms. It is clear that no integer number of 24 ms audio blocks fits in 200 ms. In fact, the average number of audio blocks per videoblock, or: per edit-block is 8,3333333. Therefore, without additional measures carried out, there will be audio blocks that cross over the edit-block borders. Editing carried out on the boundaries of such edit-blocks without further precautions may lead to severe sound artifacts since:

a- incomplete audio blocks may result

b- the difference in PTS (presentation time stamp, a parameter well known in the MPEG format) between succesive audio blocks around an edit point may not be equal to 24ms.

It is not clear how decoders will behave under these conditions.

Similar problems exists for

- any audio with NTSC video
- any audio with a sample rate of 44.1 KHz
- MPEG-1 layer II audio at an arbitrary sample rate, and
- AC-3 audio.

In accordance with the invention, audio blocks that would normally be recorded across the boundaries of the edit blocks are delayed so that they all are recorded within an edit block. Further, in order to enable a minimum lip-sync shift between the video information stored in an edit block and the audio information stored in that edit block, a lip-sync shift parameter is generated and stored in the edit block.

It should be noted here, that the invention is not limited to recording video and associated audio on a helical scan recording apparatus. The invention is equally well applicable to recording video and associated audio on any record carrier, e.g. a hard disk. Further, the first information signal need not necessarily be a video signal and the second information signal need not necessarily be an audio signal. As an example, the first information signal can be a video signal and the second information signal can be a data

signal, or the first information signal is an audio signal and the second information is a data signal.

These and other aspects of the invention will be elucidated with reference to examples in the following figure description, in which

figure 1 shows subsequent video blocks of video information and the corresponding audio information signal, subdivided in audio blocks, as a function of time,

figure 2 shows the video information and corresponding audio information recorded in edit blocks of information on the record carrier,

figure 3 shows the last track of an edit block and the first track of the next edit block and the packets of video information and packets of audio information stored in those tracks, when recording the information using a prior art recording apparatus,

figure 4 shows the last track of an edit block and the first track of the next edit block and the packets of video information and packets of audio information stored in those tracks, when recording the information in accordance with the invention,

figure 5 shows an example of an assembling process, and the resulting edited data stream of the audio information,

figure 6 shows an example of another assembling process,

figure 7 shows the result of an improved version of the assembling process of figure 5,

figure 8 shows the result of an improved version of the assembling process of figure 6,

figure 9 shows an example of an insert process and various possible resulting edited datastreams of the audio information, and

figure 10 shows an apparatus in accordance with the invention.

The invention will be explained for a specific situation, which is: PAL recording with MPEG-1 layer II audio at 48 KHz. In the following discussion, reference will be made to an `assemble' operation, as an edit situation where a second stream of video- and corresponding audio information is recorded partly over a first stream of video- and corresponding audio information, recorded earlier, and where the second stream has a length longer than the (final) portion of the first stream that was overwritten. This contrary to an

`insert' operation, where the length of the second stream is smaller than the portion of the first stream from the edit point to its end.

Figure 1 shows schematically, as a function of time, the subsequent video blocks of length 200 ms in the video signal and the subsequent blocks of length 24 ms in the corresponding audio signal. 8,33 blocks of the audio signal fit in the time interval of the video block.

Figure 2 shows schematically a portion of a record carrier 2 on which tracks T_i are shown. For explanatory purposes, the tracks are shown at an angle of 90° with reference to the longitudinal direction of the record carrier 2. In reality, however, the tracks run slantly across the record carrier, with a very small angle with reference to the longitudinal direction of the record carrier. Further, the tracks in figure 2 are shown, subdivided into ECC blocks of 12 subsequent tracks T_0 to T_{11} each.

Figure 3 shows the last track T_{11} of an ECC block and the first track T_0 of the next ECC block on an enlarged scale, compared to figure 2. Further, the tracks in figure 3 have been rotated over 90°, compared to figure 2, for clarity purposes. It is assumed that the tracks in figure 3 have been written from left to right.At the end of the track T_{11} of the first ECC block of figure 2, packets are shown recorded in the track. Further, at the beginning of the track T_0 of the second ECC block of figure 2, packets are shown recorded in the track. Only the audio packets and the video packets of the audio and corresponding video signal are shown. The video packets $VP_{i.n-2}$, $VP_{i.n-1}$, $VP_{i.n}$ are the last packets in the track T_{11} that comprise the video information belonging to the video block VF_i in figure 1.
The video packets $VP_{i+1.1}$, $VP_{i+1.2}$, $VP_{i+1.3}$, ... are the first packets in the track T_0 that comprise the video information belonging to the video block VF_{i+1} in figure 1. The video packets are shown in figure 3 by the hatched portions in the tracks T_{11} and T_0. The audio information comprised in the audio block AF_j is accommodated in the audio packets $AP_{j.1}$ to $AP_{j.l}$. As can be seen in figure 3, the audio packets $AP_{j.1}$ to $AP_{j.k}$ are located in the track T_{11} and the audio packets $AP_{j.k+1}$ to $AP_{j.l}$ are recorded in the track T_0 of the next ECC block.

Editing the video signal and corresponding audio signal by starting recording at the boundary between the ECC blocks, that means: starting recording in the track T_0 in figure 3, thus results in part of the audio block AF_j being overwritten with new information.

A solution for this problem is to shift the start of each audio block that is crossing an edit-block border to the next edit-block. This is shown in figure 4, which figure shows the same tracks T_{11} and T_0 as shown in figure 3. The audio packet $AP_{j-1.l}$ is the last audio packet in the track T_{11} and comprises audio information of the audio block AF_{j-1}.

Recording of the audio packets $AP_{j.1}$, $AP_{j.2}$ to $AP_{j.k}$ is delayed until the write head starts writing the track T_0. From figure 4 it is clear that all audio packets $AP_{j.1}$ to $AP_{j.l}$ are now recorded in the track T_0. Delaying the writing of the audio packets $AP_{j.1}$ to $AP_{j.k}$, results in less audio packets being written in the track T_{11}, compared to the situation in figure 3. This can be overcome by writing dummy packets in the track T_{11}. The proposed solution results in a sequence of edit-blocks which have either 8 or 9 audio blocks in the following order : 8 8 9 8 8 9 8 8 9 8 .....

In the first edit-block, the last audio block-start is shifted forward by 1/3 blocktime, so that this block is totally in the second edit block. The second edit block has received the first part of its first block from the first edit block. Its last audio block_start is shifted forward by 2/3 blocktime into the third edit block. The third edit block has received 2/3 of its first block from the second edit block, etc....

The third edit block now comprises one audio block of information more than the other two. This is no problem, as the information content in the edit block is sufficient to accommodate this extra audio block. Further, note, that shifting the start of an audio block-start does not have any negative effect on under- and overflow margins in the audio decoder buffer. In fact, what counts for decoding is the time at which the last byte of an audio block is present in the buffer. Of course, the momentary bit rate for audio must always be kept low enough to prevent transport buffer overflows (sustained bit-rate < 2Mb/s in MPEG).

Next, the assemble process will be further described with reference to figure 5. Figure 5 shows schematically a first datastream S_1 comprising a video information signal and a corresponding audio signal, recorded in the way described above with reference to figure 4, and second datastream S_2 comprising a video information signal and a corresponding audio signal generated in the same way. The second datastream may have been recorded as well.

Editing will be done at the location between the edit blocks EB_i and EB_{i+1} in the first datastream S_1, and the remaining portion of this datastream, starting with the edit block EB_{i+1}, will be overwritten by the portion of the datastream S_2, starting from the edit block EB_{j+1} in this datastream. The result of this editing process is the datastream S_e shown in figure 5. Clearly visible in figure 5 is that the edited datastream S_e has four edit blocks in a row comprising only 8 audio packets.

Editing two datastreams requires that the PCRs (the program clock reference values in the MPEG standard), as well as the PTS (the presentation time stamp values) both stored in the datastream, should be adjusted for the edited portion. This adjustment of the PCR means that, after an assemble, the PCR is made continuous across each assemble point. This

can be realized in an easy way, by detecting the last PCR value in the original datastream, just before the edit point, detecting the first PCR value in the datastream to be added to the original datastream in the assemble process, and adjust this PCR value and the subsequent PCR values in the datastream to be added in the assembling step by an amount which makes the PCR values continuous across the assembling point. Next, the PTS values should be adjusted with the same amount in order to maintain the same timing relationship between the PCR values and the PTS values in the edited datastream.

In the normal situation, the difference between two consecutive PTS values for two consecutive audio blocks is equal to 24 ms. Upon assembling, however, the time difference between two PTS values lying on each side of the assemble point will generally not be equal to 24 ms anymore. Therefore, the PTS values of the inserted stream shall have to be adjusted even further, before storage. This will be further explained in an example given below.

The PTS of the first audio block of the edit block EB_{i+1} in the original stream S_1 has a PTS that is 16 ms smaller than the PTS of the first block of the first edit block of the inserted stream, which is the edit block EB_{j+1} of the stream S_2. This because of the fact that the original position of this first audio block in the edit block EB_{i+1} was 2/3 block time to the left, viewed in time, of the boundary between the video blocks i+1 and i+2, see figure 1. Therefore all PTS's in the inserted stream must be decreased by 16 ms in order to keep the distance between the PTS's of the old and inserted edit blocks equal to 24 ms. However, since video PTS's cannot be changed accordingly, this change of the PTS values results in a lip-sync problem of 16 ms. The lip-sync problem increases if more assembles are made using already assembled streams.

Figure 6 shows an assemble between the two datastreams S_1 and S_2, where the assemble point is between the edit blocks EB_l and EB_{l+1} in datastream S_1 and between the edit blocks EB_m and EB_{m+1} in datastream S_2. This results in the edited datastream S_e in figure 6. It is clearly visible in figure 6 that the edited datastream S_e has now two directly successive edit blocks comprising 9 audio blocks. Such situation also leads to lip-sync problems, for the following reasons.

The PTS of the first audio block of the edit block EB_{l+1} in the original stream S_1 has a PTS that is 16 ms larger than the PTS of the first block of the first edit block of the inserted stream, which is the edit block EB_{m+1} of the stream S_2. This because of the fact that the original position of this first audio block in the edit block EB_{m+1} is at the start of a video block, whilst the original position of the first audio block in the edit block EB_{m+1} is 2/3 block

time to the left, viewed in time, of the boundary between the video blocks i+1 and i+2, see figure 1. Therefore all PTS's in the inserted stream must be increased by 16 ms in order to keep the distance between the PTS's of the old and inserted edit blocks equal to 24 ms.

It will be clear that some precautions are needed in order to minimize the effect of lip-sync shift as far as possible. Those precautions are in the form of adding a lip-sync shift parameter to each video block, as well as the insertion or deletion of audio blocks at editing points.

In the assemble situation of figure 5, an insertion of an extra audio block in e.g. the edit block EB_{j+1} in datastream S_e could be contemplated. The simplest way of inserting audio blocks is to insert "silent" audio blocks or "mute" blocks: blocks with all corresponding audio samples in the time domain equal to zero. Note that sufficient space must be kept free in the transport stream to allow for this. In the encoder, the transportstream comprising each of the original datastreams S_1 or S_2 can be prepared for later mute block insertion by inserting "mute"-blocks in transport stream packets with a selected private PID number. In the original datastreams, those “mute” blocks are, although present, ‘invisible’ upon decoding the datastream. In that case, during an assemble, the recorder needs only to change this private PID number to the audio PID in order to insert a mute block. A more sophisticated method makes use of the insertion in an edit block of copies of the last audio block in the preceding edit block, which copy is then provided with the above introduced private PID number so as to make the copy ‘invisible’ upon decoding of the original datastream. Again, during an assemble, only the PID number of the copy needs to be changed. In this case, assembles and inserts without any mute effect can be accomplished.

In the assemble situation of figure 6, a deletion of an audio block in e.g. the edit block EB_{m+1} in the datastream could be contemplated. Deletion of audio blocks is possible by changing the PID number of transport stream packets that contain an audio block from the audio PID to a selected private PID or to the null pid ‘0x1fff’ The preferred solution is to use a private PID instead of the null PID, so that the deletion can easily be reversed by changing back the private PID to the audio PID.

By using audio block insertion and block deletion carefully, it can be assured that the lip-sync problem will always be kept in the -8ms,+8ms range, even when all possible kinds of cascaded assemble and insertion steps are carried out. For example, in the previous example of figure 5, one audio block was added at the edit point, as explained above. This results in the edited datastream shown in figure 7. The PTS of this new block will be 16 ms smaller than the original first PTS of the inserted stream. That means that the following blocks

of the inserted stream will be shifted over 24 ms in 'positive' direction, so that the lip sync shift for those blocks have been changed from - 16 ms to (+24-16=) +8ms which is in the -8ms,+8ms range. So, in the new stream of figure 7, the lip sync shift before the edit point, is zero, and after the edit point, the lip sync shift is +8 ms.

In the previous example of figure 6, it was explained that the PTS of the audio block EB_{l+1} in the original stream S_1 is 16 ms larger than the PTS of the audio block EB_{m+1} in the datastream S_2 and thus (resulted in a lip sync shift of + 16 ms) in the edited stream S_e. Therefore 16 ms could be added to all PTS's of the inserted stream in order to get a correct assemble. As has been stated above, this does not lead to stable solution if cascaded assembly is allowed. By deleting the first audio block in edit block EB_{m+1} of the inserted stream, the PTS of the next blocks in the inserted stream can be decreased by 24, and a lip-sync problem of -8ms results. This results in the datastream shown in figure 8.

An important statement that should be made, is that audio block insertion and deletion must also be applied on `old' editing points if a stream that is recorded behind another stream is itself the result of a previous assemble. In other words, for cascaded assembles, the insertion/deletion strategy must be reconsidered at every edit-cut that is put on tape.

When carrying out an insert editing process, the editing process must be slightly extended, since audio block insertion/deletion must also be performed at the end of the insert. This is shown in figure 9. Figure 9 shows a first datastream S_1 and a portion of a second datastream S_2, for insertion into the first datastream. The edited datastream S_{e1} in figure 9 is the inserted datastream without any audio block insertion or deletion carried out. The edited datastream S_{e2} in figure 9 shows the step of audio block deletion carried out on the edit block EB_m at the start of the signal S_2. However, this leads to an invalid result. In fact, the total number of audio blocks in the edited signal S_e in the edited portion is 24 whereas in the original this was 25. This inevitably leads to a PTS-gap at the end of the inserted part. In order to solve this, an extra audio block must be added at the beginning of the first edit block after the insert. This is shown in figure 9, see the edited signal S_{e3}. The first track of this first edit-block after the insert therefore has to be rewritten on tape. So in other words, a insert can be seen as two assembles.

It should be noted that an alternative solution could have been to modify the tail of the insert block. This is shown in figure 9, see the edited signal S_{e4}. It will depend on hardware complexity which method will be chosen in practice.

In the example of figure 9, with the edited datastream S_{e3} as the result of the insert step, the worst-case condition with respect to audio buffer underflow can be visualized.

In fact, the first audio block of the edit-block EB_n has a PTS that should normally have come one blocktime (24 ms) earlier on tape. However, as already mentioned before, for the decoder buffer, it is only important at what time the last byte of an audio block enters the buffer. So, if audio packets could be transmitted at an arbitrarily high bit rate, there would be no stress whatsoever on the decoder buffer margins. Because of the restriction in audio bit rate (sustained < 2 Mb/s), the last byte of the first audio block will be delayed on tape by at least

24ms . 384000 / 2000000 = 4.6ms.

where the audio bitrate is assumed to be equal to 384 kb/s.
Therefore, the underflow margin in the decoder buffer is reduced by 0.0046.48000=221 bytes. A sufficiently high operating point in the audio decoder buffer must be chosen during encoding.

Next follows the measures to be taken during recording in order to enable an efficient editing process. The following requirements can be identified.

1- Each edit block (of 12 tracks, in the present example) must contain an integer number of audio blocks.

2- The start of the first and second audio block in an edit block must be aligned to the start of the payload of a TS-packet. This means that the first audio block can be deleted at the TS level. Discontinuity indicators must be set beforehand, so that continuity counter discontinuities caused by deletion or insertion of the first audio block does not lead to errors in the decoder.

3- Due to the shifting of some audio blocks, the number of audio blocks per edit block may differ from one edit block to the other. Edit blocks that contain less audio blocks than the maximum number of audio blocks found in any edit block in the stream, must have a reserved space at the beginning. This reserved space can be used to insert an extra audio block.

4- At the beginning of each edit block or every GOP, there must be the following (private) data:

(a) A lip-sync shift parameter, indicating the shift in time in the PTS values in the audio blocks.

Further, the following parameters could also be included:

(b) the value of the first PTS in the next edit-block.

(c) the shift-on-tape of the block start of the first block of the current edit block

(d) the shift-on-tape of the block start of the first block of the next edit block

(e) a flag which indicates that the current edit block marks the beginning of an inserted part

Figure 10 shows an apparatus for recording a video information signal and the corresponding audio information signal, as explained above with reference to the figures 1 to 9. The apparatus has an input terminal 100 for receiving both signals, such as incorporated in an MPEG encoded information stream. A separator unit 102 is available for separating the packets comprising the video information signal from the MPEG encoded information stream and supplying the packets of video information to an output 104, and for separating the packets comprising the corresponding audio information signal and supplying the audio packets to an output 106. A delay unit 108 is available for delaying the audio packets, if necessary, prior to supplying the audio packets to an input 110 of a multiplexer unit 112. An input 114 of the multiplexer unit 112 is coupled to the output 104 of the separator unit 102.

An audio block generator 116 is present. The audio block generator 116 can have different functions. In one embodiment of the generator 116, the generator is adapted to generate a 'silent' or 'mute' audio block, as explained above, having its PID number set to a selected PID number or to the null PID 0x1fff, so that it is not detected as an audio block upon decoding. In another embodiment, the generator 116 is adapted to repeat an audio block and set its PID accordingly, so that it is not detected as an audio block upon decoding. In the latter embodiment, the generator 116 has a connection to the delay unit 108 or the output 106, so as to receive an audio block for 'duplication'. An output of the generator 116 is coupled to another input 118 of the multiplexer 112. The multiplexer 112 has an output 120 which is coupled to an input 122 of a write unit 124, for writing the multiplexed information on a record carrier 126. In the present embodiment, the record carrier 126 is a magnetic record carrier, such as a magnetic tape or a magnetic disk. In this embodiment, the write unit 124 comprises at least one magnetic head 128 for writing the information, which have undergone an error correction encoding step and a channel encoding step, on the record carrier. The record carrier could be of the optical type, such as the optical disk 126a.

The signal processing carried out in the apparatus is controlled by a central processing unit 130, which controls all the units in the apparatus via signal control lines, only schematically shown by the line 132.

The apparatus of figure 10 is also capable of carrying out an assemble or an insert step. In order to enable assembling and insertion, the apparatus is also capable of reading the information from the record carrier 126, so as to establish the assemble point or the insert points. Further, it is required to retrieve the following information from the record carrier:

- the PCR value at the assemble point or the insert points
- the lip-sync parameter of the information before the assemble point or before and after the insert points.

At an assemble, the signal processing must perform the following tasks:

1. Correct the time-base (PCR) of the assembled stream, so there should be no time-base discontinuity at the edit point (PCR)
2. Correct PTS first for the new time-base. Where PTS first is the first PTS of the first edit block in the assembled stream.
3. Calculate the PTS target for the first edit block in the inserted stream by adding a block period to the last PTS in the stream on tape.
4. Subtract the PTS first from PTS target : PTSdif=PTStarget-PTSfirst
5. add or delete an audio block on the basis of the following tests (A is the lip-sync shift of the first edit block in the inserted stream, Tblock is an audio block period):

```
if (abs(PTSdif+A-Tblock) < abs(PTSdif)) then /* lip-sync gets better if a block is deleted */
delete_first_block();

if (abs(PTSdif+A+Tblock) < abs(PTSdif)) then /* lip-sync gets better if a block is added */
add_new_block();
```

6. Keep monitoring the assembled stream. Repeat the algorithm for every inserted edit-block.
7. PCR's, PTS's and the lip-sync parameter in the inserted stream must be adjusted for every assembled edit-block.
8. for an insert, it may be necessary to add an audio block or delete an audio block in the first edit block after the inserted piece. In this case, the first track of that specific edit-block must be read and rewritten.

Using the optional parameters (b) upto (e), given above, can significantly reduce the complexity of the algorithm.

As regards parameter (b): since in step 3) the number of audio blocks per edit block is not constant, the target PTS must be calculated by reading the last PTS in the last edit block on tape and increasing it with the audio block period. This means that the last edit-block must be read almost entirely. By using parameter (b), only the beginning of the last edit block on tape has to be read before an assemble.

As regards the parameters (c) and (d): In step 5) the decision is taken on whether or not to add or delete an audio block. However, this decision cannot be taken unless the first PTS of the new edit-block is read (see step 2 and 4). This means that it is possible, that an audio block must be inserted at a point well before a point that has already been read, which corresponds to a jump in the inserted stream. By using the parameters (c) and (d), it is possible to take a decision on the basis of data that is available at the very beginning of the edit block. In that case, data from the inserted stream can be processed as it comes into the recorder: sequentially without any jumps. Notice, that PTSdif in step 4) can also be expressed as: PTSdif=Dlast- Cfirst where Dlast is D from the last edit block on tape and Cfirst is C from the first edit block of the inserted stream.

As regards the parameter (e): step 6) strictly needs only to be performed for edit blocks that have once marked the beginning of an inserted stream. By using the flag (e), the number of operations in step 6) can therefore be reduced.

In accordance with the invention, a generic approach is presented, which allows assemble and insert with any type of audio format. Specifications are:

- A restricted lip-sync shift can be obtained , varying at least within {-Tblock/2, Tblock/2} in general. For MPEG-1 layer II, the lip-sync is less: within {-8ms,8ms}.

- During encoding the following must be done:

(1) audio blocks must be shifted over edit-block borders (some buffering is needed for that)

(2) the first audio block must fit in an integer number of TS packets (stuffing after the first block)

(3) space must be kept free in the transport stream for audio-block insertion

(4) discontinuity indicators (well known in MPEG) must be set properly

(5) a packet with private edit-information containing (at least) the lip-sync parameter must be added at the start of each edit-block or every GOP (can be a fixed packet)

- During editing the following must be done:

(1) a relatively simple algorithm must be performed for each edit block that is put on tape (worst case).

(2) After an insert, the first part of the edit block after the insert has to be rewritten.

(3) for each edit-block, the private edit-information must be updated.

Whilst the invention has been described with reference to preferred embodiments thereof, it is to be understood that these are not limitative examples. Thus, various modifications may become apparent to those skilled in the art, without departing from the scope of the invention, as defined by the claims. Further, any reference signs do not limit

the scope of the claims. The invention, as far as incorporated in the recording or editing apparatus, can be implemented by means of both hardware and software, and several "means" may be represented by the same item of hardware. The word 'comprising' does not exclude the presence of other elements or steps than those listed in a claim. Also, the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. In addition, the invention lies in each and every novel feature or combination of features.

CLAIMS:

1. Method of recording a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, on a record carrier,
- the first information signal being encoded into first blocks of information, the information comprised in a first block corresponding to a portion of the first information signal extending over a specific first time interval T_1,
- the second information signal being encoded into second blocks of information, the information comprised in a second block corresponding to a portion of the second information signal extending over a specific second time interval T_2,
where n is a ratio which is equal to T_1/T_2, the ratio n being a non integer value larger than 1, the method comprising the steps of
- receiving a serial datastream of first blocks of the first information signal and of second blocks of the second information signal,
- writing the serial datastream of the first and second blocks of information in one or more tracks on a record carrier,
the writing step comprising the substeps of
(a) writing a first block of the first information signal as well as N_1 second blocks of the second information signal that comprise a portion of information of the second information signal that lie in the first time interval corresponding to said first block of information, in a portion of the record carrier, where N_1 is the highest integer smaller than n,
(b) delaying the writing of the next second block of information,
(c) writing the next first block of information of the first information signal in a subsequent portion of the record carrier, and
(d) writing the said next second block completely into said subsequent portion of the record carrier.

2. Recording method as claimed in claim 1, wherein the writing step further comprises the substep of

(e) writing the next N_1-1 second blocks of information that comprise a portion of information of the second information signal that lie in the next first time interval corresponding to said next first block, in said next portion of the record carrier.

3. Recording method as claimed in claim 1, wherein the writing step further comprises the substep of
(e) writing the next N_1 second blocks of information that comprise a portion of information of the second information signal that lie in the next first time interval corresponding to said next first block, in said next portion of the record carrier

4. Method of recording a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, on a record carrier,
- the first information signal being encoded into first blocks of information, the information comprised in a first block corresponding to a portion of the first information signal extending over a specific first time interval T_1, the information stored in a first block being included in a plurality of first data packets,
- the second information signal being encoded into second blocks of information, the information comprised in a second block corresponding to a portion of the second information signal extending over a specific second time interval T_2, the information stored in a second block being included in a plurality of second data packets,
where n is a ratio which is equal to T_1/T_2, the ratio n being a non integer value larger than 1, the method comprising the steps of
- receiving a serial datastream comprising first data packets of the first information signal and second data packets of the second information signal,
- writing the serial datastream of packets in one or more tracks on a record carrier,
the writing step comprising the substeps of
(a) writing the first data packets corresponding to a first block of the first information signal, as well the second data packets corresponding to N_1 second blocks that comprise information that lie in the first time interval corresponding to said first block, in a portion of the record carrier, where N_1 is the highest integer smaller than n,
(b) delaying the writing of the second data packets corresponding to the next second block,
(c) writing the first data packets corresponding to the next first block of the first information signal in a subsequent portion of the record carrier, and

(d) writing the second data packets corresponding to the said next second block completely into said subsequent portion of the record carrier.

5. Recording method as claimed in claim 4, wherein the writing step further comprises the substep of
(e) writing second data packets corresponding to N_1-1 second blocks that comprise information of the second information signal that lie in the next first time interval corresponding to said next first block, in said next portion of the record carrier.

6. Recording method as claimed in claim 4, wherein the writing step further comprises the substep of
(e) writing second data packets corresponding to N_1 second blocks that comprise information of the second information signal that lie in the next first time interval corresponding to said next first block, in said next portion of the record carrier.

7. Method of recording a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, on a record carrier,
- the first information signal being encoded into first blocks of information, the information comprised in a first block corresponding to a portion of the first information signal extending over a specific first time interval T_1,
- the second information signal being encoded into second blocks of information, the information comprised in a second block corresponding to a portion of the second information signal extending over a specific second time interval T_2,
where n is a ratio which is equal to T_1/T_2, the ratio n being a non integer value larger than 1, the method comprising the steps of
- receiving a serial datastream of first blocks of the first information signal and of second blocks of the second information signal,
- writing the serial datastream of first and second blocks in one or more tracks on a record carrier,
the writing step comprising the substeps of
(a) writing subsequent first blocks of the first information signal in corresponding subsequent portions of the record carrier,

(b) subdividing the serial datastream of the second blocks in subsequent groups of N_1 or N_1 + 1 second blocks,

(c) generating an additional second block and adding the additional second block to a group of N_1 second blocks so as to convert said group of N_1 second blocks into a group of N_1+1 second blocks, the said additional second block having an identifier identifying the said additional second block as not comprising information of the second information signal,

(d) writing said group of N_1+1 second blocks in a portion of the record carrier.

8. Method of recording a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, on a record carrier,

- the first information signal being encoded into first blocks of information, the information comprised in a first block corresponding to a portion of the first information signal extending over a specific first time interval T_1,

- the second information signal being encoded into second blocks of information, the information comprised in a second block corresponding to a portion of the second information signal extending over a specific second time interval T_2,

where n is a ratio which is equal to T_1/T_2, the ratio n being a non integer value larger than 1, the method comprising the steps of

- receiving a serial datastream of first blocks of the first information signal and of second blocks of the second information signal,

- writing the serial datastream of first and second blocks in one or more tracks on a record carrier, the writing step comprising the substeps of

(a) writing subsequent first blocks of the first information signal in corresponding subsequent portions of the record carrier,

(b) subdividing the serial datastream of the second blocks in subsequent groups of N_1 or N_1 + 1 second blocks,

(c) adding a second block to a group of N_1 second blocks so as to convert the said group of N_1 second blocks into a group of N_1+1 second blocks, the said added second block being the first block of said group of N_1+1 second blocks and being a repetition of the last second block in the directly preceding group of second blocks, the said added second block having an identifier identifying the said added second block as if not comprising information of the second information signal,

(d) writing the said group of N_1+1 second blocks in a portion of the record carrier.

9. Method as claimed in claim 7 or 8, wherein said substep (c) comprises adding a second block to each group of N_1 second blocks so as to obtain groups of $N_1 +1$ second blocks, and said substep (d) comprises writing the subsequent groups of N_1+1 second blocks in corresponding subsequent portions of the record carrier.

10. Method as claimed in claim 1, 4, 7 or 8, the method further comprising the steps of

- generating a lip-sync shift parameter,
- writing a lip-sync shift parameter in a said portion of the record carrier, the lip-sync shift parameter written in the portion having a relationship with the shift in time between the first information signal written in said portion and the second information signal written in said portion.

11. Method of editing a first information signal and a corresponding second information signal, recorded on a record carrier, by one of the methods as claimed in anyone of the claims 1 to 10,

- the first information signal being encoded into first blocks of information, subsequent first blocks of the first information signal being recorded in subsequent portions of the record carrier,
- the second information signal being encoded into second blocks of information, a plurality of subsequent second blocks of the second information signal being recorded in each of said subsequent portions of said record carrier,

the method comprises the steps of

- receiving a third information signal which is of the same type as the first information signal and a corresponding fourth information signal which is of the same type as the second information signal, the third information signal being encoded into third blocks of information, being of substantially the same length as the first blocks of information, and the fourth information signal being encoded into fourth blocks of information, being of the same length as the second blocks of information,
- writing the third information signal and the corresponding fourth information signal on the record carrier, starting from an edit position on said record carrier, said edit position coinciding with a boundary between two subsequent portions of said record carrier,

the writing step comprising the substeps of

(a) writing subsequent third blocks of the third information signal in subsequent portions of the record carrier, starting from said edit position,

(b) writing groups of N_1 fourth blocks of the fourth information signal or groups of N_1+1 fourth blocks of the fourth information signal in the subsequent portions of the record carrier, starting from said edit position.

12. Method of editing as claimed in claim 11, the second blocks of the second information signal as recorded on the record carrier as well as the fourth blocks of the fourth information signal to be recorded on the record carrier comprising a presentation time stamp, the method further comprising the step of modifying the presentation time stamps of the fourth blocks prior to recording the fourth blocks on the record carrier, in order to make the time stamps continuous across an edit position.

13. Method of editing as claimed in claim 12, the second blocks of the second information signal as recorded on the record carrier as well as the fourth blocks of the fourth information signal to be recorded on the record carrier comprising a lip sync shift parameter, the method further comprising the steps of modifying the lip sync shift parameter for said fourth blocks at least in response to the amount of modification of the time stamps for said fourth blocks, prior to recording said fourth blocks on the record carrier.

14. Method of editing as claimed in claim 13, further comprising the step of
- adding an additional fourth block to the group of N_1 fourth blocks intended for writing in the first portion of the record carrier directly after the edit position in the event that the modified lip sync parameter for the fourth blocks exceed a predetermined threshold value.

15. Method of editing as claimed in claim 14, further comprising the step of
- further modifying the presentation time stamps for the fourth blocks, in order to make the time stamps of the fourth blocks, including the additional fourth block, continuous across the edit point

16. Method of editing as claimed in claim 14, further comprising the step of
- further modifying the lip sync parameter of the fourth blocks in response to said adding of said additional fourth block.

17. Method of editing as claimed in claim 14, wherein said additional fourth block is a repetition of the first of said N_1 fourth blocks, said additional fourth block comprising an identifier indicating as if said additional fourth block does not comprise information of the fourth information signal.

18. Method of editing as claimed in claim 14, wherein said additional fourth block has an identifier identifying the said additional fourth block as not comprising information of the fourth information signal.

19. Apparatus for recording a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, on a record carrier,

- the first information signal being encoded into first blocks of information, the information comprised in a first block corresponding to a portion of the first information signal extending over a specific first time interval T_1,
- the second information signal being encoded into second blocks of information, the information comprised in a second block corresponding to a portion of the second information signal extending over a specific second time interval T_2,

where n is a ratio which is equal to T_1/T_2, the ratio n being a non integer value larger than 1, the apparatus comprising:

- input means for receiving a serial datastream of first blocks of the first information signal and of second blocks of the second information signal,
- writing means for writing the serial datastream of the first and second blocks of information in one or more tracks on the record carrier,

the writing means comprising:

(a) first means for writing a first block of the first information signal as well as N_1 second blocks of the second information signal that comprise a portion of information of the second information signal that lie in the first time interval corresponding to said first block of information, in a portion of the record carrier, where N_1 is the highest integer smaller than n,

(b) delay means for delaying the writing of the next second block of information,

(c) second means for writing the next first block of information of the first information signal in a subsequent portion of the record carrier, and

(d) third means for writing the said next second block completely into said subsequent portion of the record carrier.

20. Recording apparatus as claimed in claim 19, wherein the writing means further comprises:

(e) fourth means for writing the next N_1-1 second blocks of information that comprise a portion of information of the second information signal that lie in the next first time interval corresponding to said next first block, in said next portion of the record carrier.

21. Recording apparatus as claimed in claim 19, wherein the writing means further comprises:

(e) fourth means for writing the next N_1 second blocks of information that comprise a portion of information of the second information signal that lie in the next first time interval corresponding to said next first block, in said next portion of the record carrier

22. Apparatus for recording a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, on a record carrier,

- the first information signal being encoded into first blocks of information, the information comprised in a first block corresponding to a portion of the first information signal extending over a specific first time interval T_1, the information stored in a first block being included in a plurality of first data packets,

- the second information signal being encoded into second blocks of information, the information comprised in a second block corresponding to a portion of the second information signal extending over a specific second time interval T_2, the information stored in a second block being included in a plurality of second data packets,

where n is a ratio which is equal to T_1/T_2, the ratio n being a non integer value larger than 1, the apparatus comprising:

- input means for receiving a serial datastream comprising first data packets of the first information signal and second data packets of the second information signal,

- writing means for writing the serial datastream of packets in one or more tracks on a record carrier,

the writing means comprising:

(a) first means for writing the first data packets corresponding to a first block of the first information signal, as well the second data packets corresponding to N_1 second blocks that

comprise information that lie in the first time interval corresponding to said first block, in a portion of the record carrier, where N_1 is the highest integer smaller than n,
(b) delay means for delaying the writing of the second data packets corresponding to the next second block,
(c) second means for writing the first data packets corresponding to the next first block of the first information signal in a subsequent portion of the record carrier, and
(d) third means for writing the second data packets corresponding to the said next second block completely into said subsequent portion of the record carrier.

23. Recording apparatus as claimed in claim 22, wherein the writing means further comprises:
(e) fourth means for writing second data packets corresponding to N_1-1 second blocks that comprise information of the second information signal that lie in the next first time interval corresponding to said next first block, in said next portion of the record carrier.

24. Recording apparatus as claimed in claim 22, wherein the writing means further comprises:
(e) fourth means for writing second data packets corresponding to N_1 second blocks that comprise information of the second information signal that lie in the next first time interval corresponding to said next first block, in said next portion of the record carrier.

25. Apparatus for recording a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, on a record carrier,
- the first information signal being encoded into first blocks of information, the information comprised in a first block corresponding to a portion of the first information signal extending over a specific first time interval T_1,
- the second information signal being encoded into second blocks of information, the information comprised in a second block corresponding to a portion of the second information signal extending over a specific second time interval T_2,
where n is a ratio which is equal to T_1/T_2, the ratio n being a non integer value larger than 1, the apparatus comprising:
- input means for receiving a serial datastream of first blocks of the first information signal and of second blocks of the second information signal,

- writing means for writing the serial datastream of first and second blocks in one or more tracks on a record carrier,

the writing means comprising:

(a) first means for writing subsequent first blocks of the first information signal in corresponding subsequent portions of the record carrier,

(b) second means for subdividing the serial datastream of the second blocks in subsequent groups of N_1 or $N_1 + 1$ second blocks,

(c) third means for generating an additional second block and adding the additional second block to a group of N_1 second blocks so as to convert said group of N_1 second blocks into a group of N_1+1 second blocks, the said additional second block having an identifier identifying the said additional second block as not comprising information of the second information signal,

(d) fourth means for writing said group of N_1+1 second blocks in a portion of the record carrier.

26. Apparatus for recording a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, on a record carrier,

- the first information signal being encoded into first blocks of information, the information comprised in a first block corresponding to a portion of the first information signal extending over a specific first time interval T_1,

- the second information signal being encoded into second blocks of information, the information comprised in a second block corresponding to a portion of the second information signal extending over a specific second time interval T_2,

where n is a ratio which is equal to T_1/T_2, the ratio n being a non integer value larger than 1, the apparatus comprising:

- input means for receiving a serial datastream of first blocks of the first information signal and of second blocks of the second information signal,

- writing means for writing the serial datastream of first and second blocks in one or more tracks on a record carrier, the writing means comprising:

(a) first means for writing subsequent first blocks of the first information signal in corresponding subsequent portions of the record carrier,

(b) second means for subdividing the serial datastream of the second blocks in subsequent groups of N_1 or $N_1 + 1$ second blocks,

(c) third means for adding a second block to a group of N_1 second blocks so as to convert the said group of N_1 second blocks into a group of N_1+1 second blocks, the said added second block being the first block of said group of N_1+1 second blocks and being a repetition of the last second block in the directly preceding group of second blocks, the said added second block having an identifier identifying the said added second block as if not comprising information of the second information signal,

(d) fourth means for writing the said group of N_1+1 second blocks in a portion of the record carrier.

27. Apparatus as claimed in claim 25 or 26, wherein said third means comprises fifth means for adding a second block to each group of N_1 second blocks so as to obtain groups of N_1 +1 second blocks, and said fourth means comprises sixth means for writing the subsequent groups of N_1+1 second blocks in corresponding subsequent portions of the record carrier.

28. Apparatus as claimed in claim 19, 22, 25 or 26, the apparatus further comprising:

- means for generating a lip-sync shift parameter,
- means for writing a lip-sync shift parameter in a said portion of the record carrier, the lip-sync shift parameter written in the portion having a relationship with the shift in time between the first information signal written in said portion and the second information signal written in said portion.

29. Apparatus for editing a first information signal and a corresponding second information signal, recorded on a record carrier, by one of the apparatuses as claimed in anyone of the claims 19 to 28,

- the first information signal being encoded into first blocks of information, subsequent first blocks of the first information signal being recorded in subsequent portions of the record carrier,
- the second information signal being encoded into second blocks of information, a plurality of subsequent second blocks of the second information signal being recorded in each of said subsequent portions of said record carrier,

the apparatus comprising:

- input means for receiving a third information signal which is of the same type as the first information signal and a corresponding fourth information signal which is of the same type as the second information signal, the third information signal being encoded into third blocks of information, being of substantially the same length as the first blocks of information, and the fourth information signal being encoded into fourth blocks of information, being of the same length as the second blocks of information,

- writing means for writing the third information signal and the corresponding fourth information signal on the record carrier, starting from an edit position on said record carrier, said edit position coinciding with a boundary between two subsequent portions of said record carrier,

the writing means comprising:

(a) first means for writing subsequent third blocks of the third information signal in subsequent portions of the record carrier, starting from said edit position,

(b) second means for writing groups of N_1 fourth blocks of the fourth information signal or groups of N_1+1 fourth blocks of the fourth information signal in the subsequent portions of the record carrier, starting from said edit position.

30. Apparatus for editing as claimed in claim 29, the second blocks of the second information signal as recorded on the record carrier as well as the fourth blocks of the fourth information signal to be recorded on the record carrier comprising a presentation time stamp, the apparatus further comprising first modifying means for modifying the presentation time stamps of the fourth blocks prior to recording the fourth blocks on the record carrier, in order to make the time stamps continuous across an edit position.

31. Apparatus for editing as claimed in claim 30, the second blocks of the second information signal as recorded on the record carrier as well as the fourth blocks of the fourth information signal to be recorded on the record carrier comprising a lip sync shift parameter, the apparatus further comprising second modifying means for modifying the lip sync shift parameter for said fourth blocks at least in response to the amount of modification of the time stamps for said fourth blocks, prior to recording said fourth blocks on the record carrier.

32. Apparatus for editing as claimed in claim 31, further comprising

- means for adding an additional fourth block to the group of N_1 fourth blocks intended for writing in the first portion of the record carrier directly after the edit position in the event that the modified lip sync parameter for the fourth blocks exceed a predetermined threshold value.

33. Apparatus for editing as claimed in claim 32, said first modifying means being further adapted to further modify the presentation time stamps for the fourth blocks, in order to make the time stamps of the fourth blocks, including the additional fourth block, continuous across the edit point

34. Apparatus for editing as claimed in claim 32, said second modifying means being further adapted to further modify the lip sync parameter of the fourth blocks in response to said adding of said additional fourth block.

35. Apparatus for editing as claimed in claim 32, wherein said additional fourth block is a repetition of the first of said N_1 fourth blocks, said additional fourth block comprising an identifier indicating as if said additional fourth block does not comprise information of the fourth information signal.

36. Apparatus for editing as claimed in claim 32, wherein said additional fourth block has an identifier identifying the said additional fourth block as not comprising information of the fourth information signal.

37. Record carrier having a first information signal, such as a digital video signal, and a corresponding second information signal, such as a digital audio information signal, recorded on it,

- the first information signal being encoded into first blocks of information, the information comprised in a first block corresponding to a portion of the first information signal extending over a specific first time interval T_1,

- the second information signal being encoded into second blocks of information, the information comprised in a second block corresponding to a portion of the second information signal extending over a specific second time interval T_2,

where n is a ratio which is equal to T_1/T_2, the ratio n being a non integer value larger than 1, the record carrier having subsequent first blocks of the first information signal and subsequent second blocks of the second information signal recorded in subsequent portions of the record

carrier, in such a way that a first block of the first information signal as well as N_1 second blocks of the second information signal that comprise a portion of information of the second information signal that lie in the first time interval corresponding to said first block of information being recorded in the same portion of the record carrier, where N_1 is the highest integer smaller than n, and the next first block of information of the first information signal being recorded in a subsequent portion of the record carrier, together with the next second block.

ABSTRACT:

The serial datastream of MPEG encoded information comprises packets of an MPEG encoded video signal and comprises packets of a corresponding audio signal. The MPEG encoded video signal is in the form of frames, e.g. of length 200 ms. The MPEG encoded audio signal is in the form of blocks of audio information. As an example, for an audio signal encoded in accordance with MPEG-1 layer II at 48 kHz, the block-length is 1152 samples which represents 24 ms. It is clear that no integer number of 24 ms audio blocks fits in 200 ms. In fact, the average number of audio blocks per videoblock, or: per edit-block is 8,3333333. Therefore, without additional measures carried out, there will be audio blocks that cross over the edit-block borders. Editing carried out on the boundaries of such edit-blocks without further precautions may lead to severe sound artifacts. Various measures are proposed to enable editing, and limiting the artifacts.
(Fig. 1)

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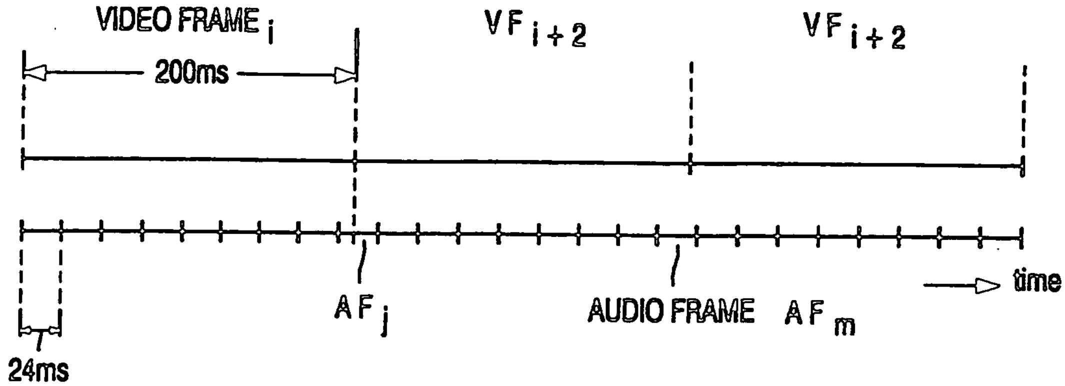

FIG. 1

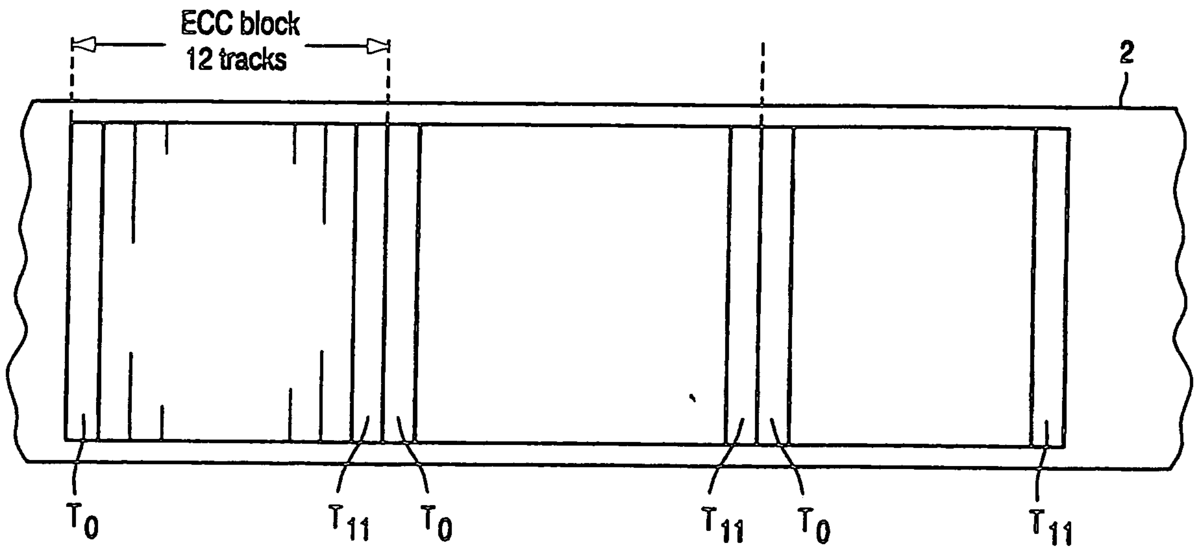

FIG. 2

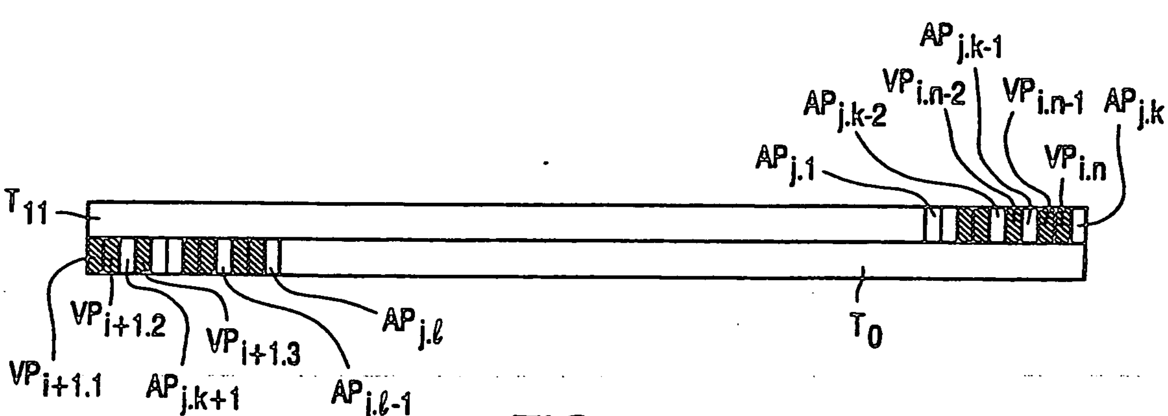

FIG. 3

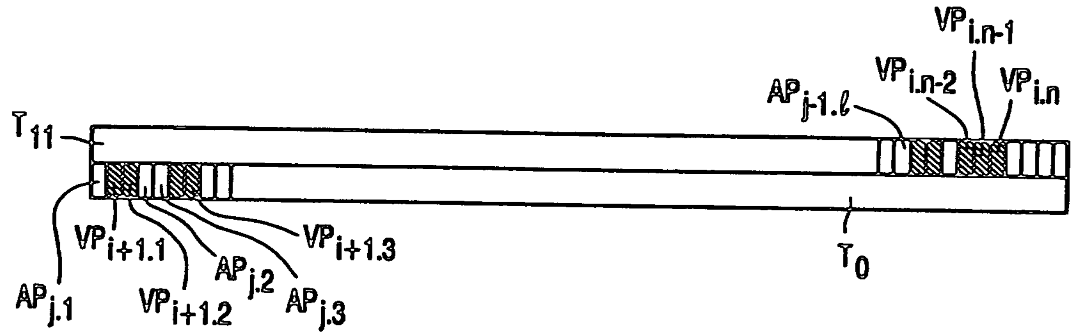

FIG. 4

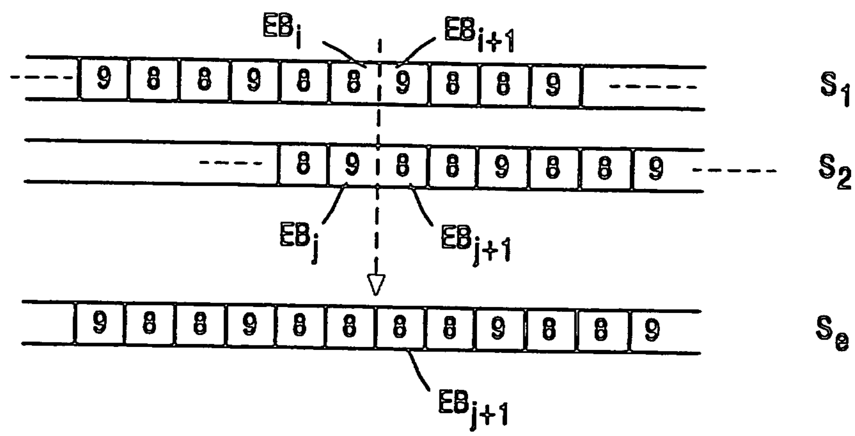

FIG. 5

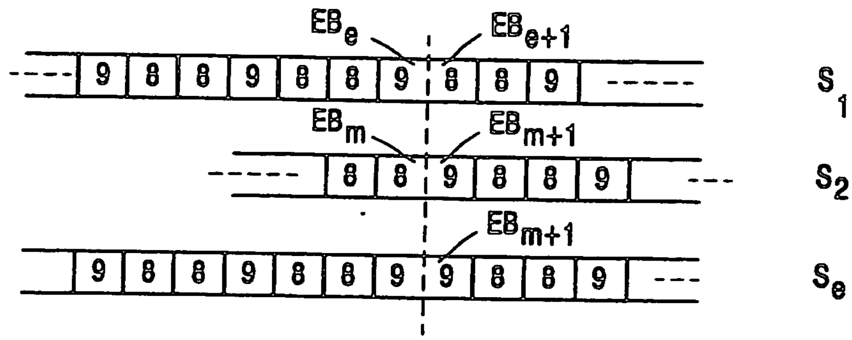

FIG. 6

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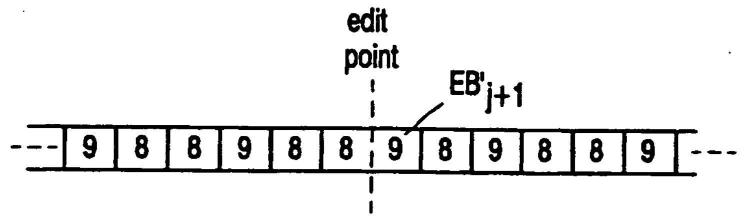


FIG. 7

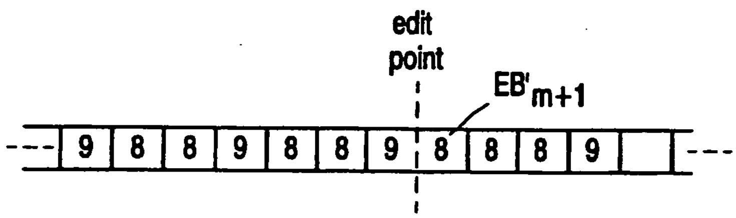


FIG. 8

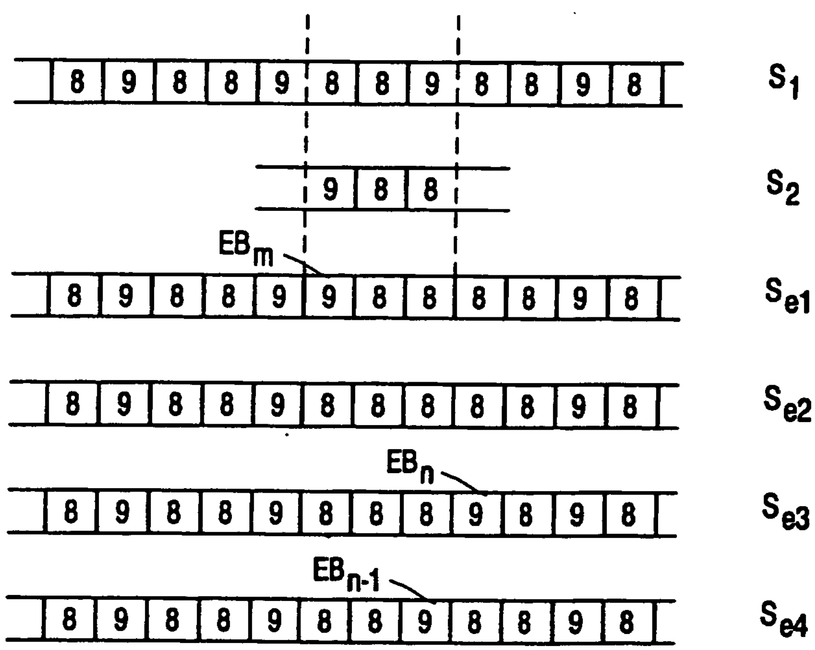
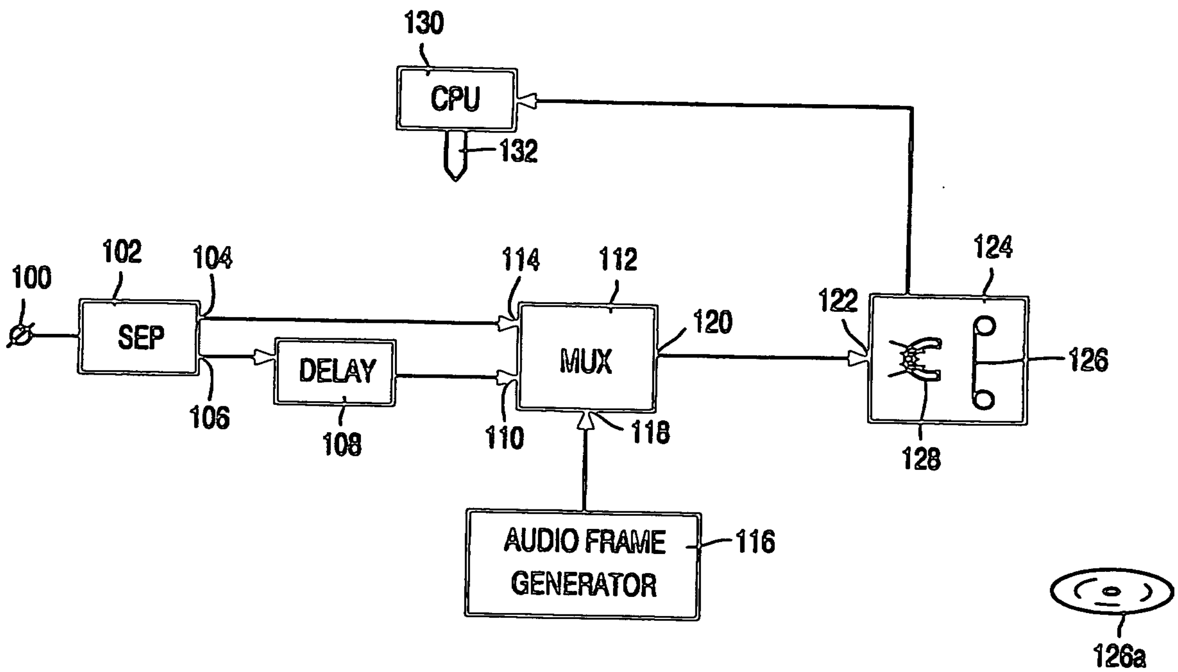


FIG. 9


130
CPU
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SEP
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DELAY
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MUX
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AUDIO FRAME GENERATOR
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FIG. 10

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